

# Synopsis

Emission of oxides of nitrogen from gasoline powered vehicles has declined due to improved catalytic techniques, however, the same from diesel powered vehicles has increased substantially in the last thirty years. Total diesel fuel consumption has increased approximately 5% per year, which corresponds to a doubling in 15 years. Diesel now amounts to 25% of fuel used in on and off-road engines. In the on-road engines category though the heavy-duty diesel trucks dominate nitrogen oxide emissions it is limited to the countryside. The emission from the urban driven vehicles, though in small proportions, is the one which is of main concern today from the health point of view. The off-road emissions are more or less distributed. Diesel emission also contributes substantially to ambient concentrations of particulate matter. There are trade-offs between fuel economy, particulate matter and oxides of nitrogen emission in injection-timed engines. Post-treatment devices including nitrogen oxide absorber catalyst and urea injection are being developed. The effectiveness of current emission control technologies in further reducing main pollutants in diesel exhaust is limited. An alternative technique based on the plasma technology which is having a potential to address future emission requirements from internal combustion engines is currently being studied across the globe and forms a basis in the current work.

In this thesis electric discharge plasma removal of oxides of nitrogen assisted by existing aftertreatment techniques has been studied. Exhaust from diesel engine with and without any filtering has been treated. The following points are studied in detail

- Filtered exhaust treatment by discharge plasma
- Raw exhaust treatment by non thermal plasma
- Feasibility study of hybrid plasma adsorbent operation
- Feasibility study of hybrid Plasma catalyst operation
- Feasibility study of plasma adsorbent catalyst operation

Experiments are carried out at 0% and 50% loading of the engine. Performance of plasma reactor in presence of oil mist, unburned hydrocarbons and water vapor has been studied. Two different geometry of plasma reactor has been used to vary the energy deposition by electrical discharges. Different kinds of adsorbents and catalysts are being used in the course of experiments.

The first chapter provides introduction about the air pollutants, their affects on human health, the existing emission control technologies and their limitations. It gives an overview of electrical discharges for abatement of air pollutants, a literature survey and the scope of present work. Details of the experimental set up, technical specifications of different equipments and materials used in this work are explained in the second chapter.

Chapter three discusses the results obtained out of the present work. Among the different hazardous gases present in the diesel exhaust emphasis has been laid on NO<sub>x</sub> and CO. Also some experiments were carried out for combined NO<sub>x</sub> and CO removal. In order to study the effect of initial concentration of pollutants experiments were performed at higher loading of the engine. Discharge plasma technique and other existing techniques like adsorption and catalysis were studied individually and their hybrid operation was investigated. Chapter four lists out the major inferences drawn from this study.

Some of the important observations of the present thesis have been resulted in a research paper entitled “*Unfiltered Diesel Engine Exhaust Treatment by Discharge plasma Effect of Soot Oxidation*” and is going to publish in journal of *Plasma Science and Technology*, August 2004 issue.